

Active pullup/pulldown network saves watts

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THE CONTROL CIRCUIT in **Figure 1** presents a relatively low input resistance and thus imposes a low value on external pulldown resistor R_1 to provide the desired low-level input voltage. In turn, R_1 wastes power by drawing a relatively high current through switch S_1 . For example, suppose that the control circuit presents an input resistance of 2.2 k Ω and requires a logic-low input of 5V or less. At a V_{CC} of 24V, R_1 must not exceed 500 Ω for a current drain of $24/500=48$ mA. The power dissipated in R_1 is thus $24^2/0.5=1152$ mW, which requires a 2W resistor for reliable operation.

In this application, the system includes three controls with three input circuits, which present a total current of 432 mA

and adds approximately 10W to the power budget. To reduce wasted power, it uses an active pulldown circuit (inside the dashed line in **Figure 2**). As long as switch S_1 remains closed, PNP transistor Q_1 's base voltage exceeds its emitter voltage due to diode D_1 's forward voltage drop. Thus, Q_1 doesn't conduct, and the control circuit's input voltage rests at $V_{CC}-0.7V$ (D_1 's forward voltage drop).

Opening S_1 reverse-biases D_1 , and the base current flowing through resistor R_1 turns on Q_1 , which saturates and pulls the

circuit's input to $V_{CE(SAT)}$. Closed-circuit current through S_1 is thus V_{CC}/R_1 . For example, with V_{CC} of 24V and R_1 having a value of 10 k Ω , $I=24/10=2.4$ mA, and R_1 dissipates 0.058W, or approximately 20 times less power than in **Figure 1**. In this application, current demand of the nine control-circuit inputs decreases from 432 to 22 mA and saves pc-board space by eliminating the need for using 2W. As a variant, **Figure 3** shows an active-pullup version of the circuit. □

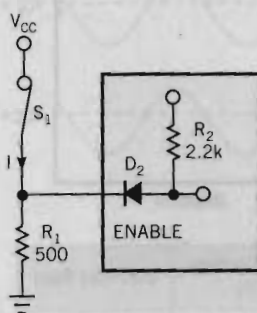


Figure 1 A conventional network requires a low-value pulldown resistor.

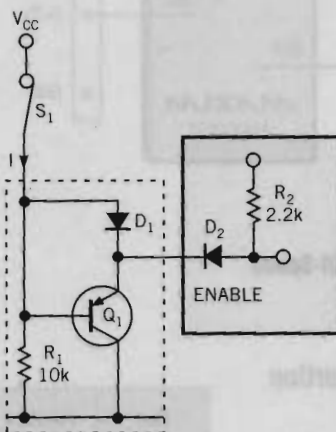


Figure 2 An active pulldown circuit substitutes a saturated transistor for a power-consuming pulldown resistor.

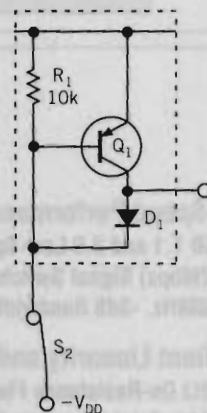


Figure 3 Rearranging the circuit and using an NPN transistor for Q_1 yields an active-pullup network.

Sine-wave step-up converter uses Class E concept

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MANY POWER APPLICATIONS ranging from luminescent and fluorescent lighting to telephone-ringing voltage generators require a more or less sinusoidal-drive voltage. These applications typically require a waveform of only moderate quality, and its frequency isn't especially critical. However, avoiding waveform discontinuities that cause unwanted current peaks, excessive device

dissipation, and EMC problems rules out using filtered square waves or other stepped waveforms. Sometimes, a trapezoidal drive may be acceptable but it's only a second choice at best. This Design Idea proposes a method of generating sine waves that offers a number of advantages over more complex methods:

The circuit requires only one power-switching device, and you can use an ana-

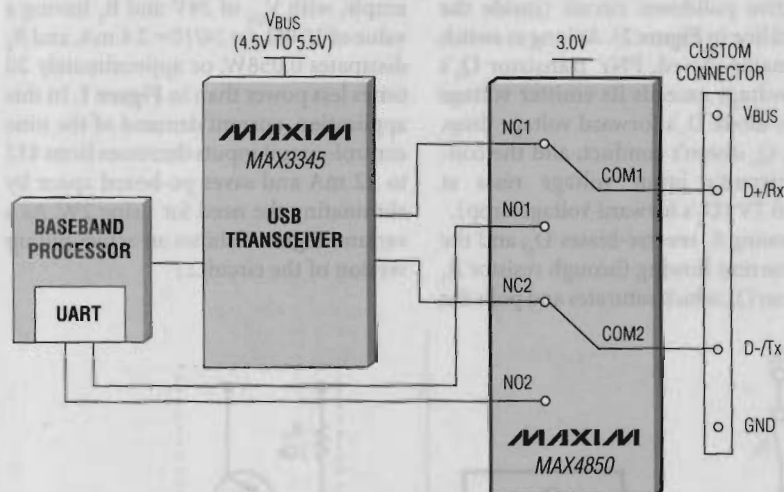
log or a digital signal to drive the switching device. The circuit also requires only a few components: a diode, a switching transistor or a MOSFET, an inductor or a transformer, and a capacitor. Further, the design's circuit losses are low, and the switching device experiences minimal stress during operation. **Figure 1** shows the basic circuit, and **Figure 2** illustrates

(continued on pg 86)

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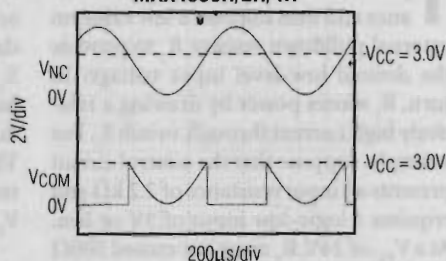
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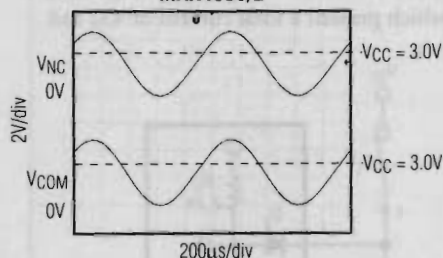
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